

TO MY HUSBAND, BRADLEY....

A RESOURCE GUIDE TO PHYSICAL SCIENCE/PHYSICS SOFTWARE
FOR THE APPLE II, ATARI, PET, AND TRS-80

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REPORT

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CHAPTER 1

INTRODUCTION

Technological advancement has led to the use of computers in most aspects of life. The price of computers (microcomputers) has decreased to be within the range of individual schools and classroom budgets (Eisele, 1979). A recent survey conducted by the U.S. Department of Education revealed that about one-half of the nation's school districts provide students with access to at least one microcomputer or computer terminal. At least 52,000 microcomputers and computer terminals are currently available for student use (Eisele, 1981). It has been predicted that within the decade, computers will become commonplace in education (Bork, 1981 and Vannatta, 1981).

Austin Independent School District (AISD) has been affected by this expansion of computers in education. Each high school in AISD has an average of six microcomputers and/or computer terminals. Each junior high has at least one microcomputer; some have as many as six. This year every high school received one TRS-80, except Crockett High School and Anderson High School which received two. (See Appendix A for an inventory of the software and computers in each of the high schools). In the Fall 1983, two VIC-20's will be installed in each of the junior high schools in AISD (personal communication, 1982).

In general, reasons for the increasing use of microcomputers in education besides the low cost are as follows. The main argument for microcomputers is the need for independent or individualized learning.

Computer programs possess the potential of correcting responses, keeping records, and test averaging, thus relieving the teacher of routine work and freeing him for the work of helping the slow learner, preparing more effective lectures, etc. (McCulloch, 1980). Research has shown that the use of computers in instruction leads to greater achievement and motivation than conventional lock-step approaches (Charp, 1981). One indication of the positive appeal of computer controlled activities is the popularity of video games (Vannatta, 1981).

Most important, since society is becoming more dependent upon computers, concern is voiced that schools are not preparing future citizens to deal with this computerized world. Some school districts are now requiring a computer literacy course before graduation (for example Maple Lake, Minnesota and Orange County, California) (Charp, 1981 and Hansen, et. al., 1981). It is estimated that 60%-70% of future jobs may require some familiarity with computers. A noted authority on microcomputers stated, "Ignorance of computers will render people as functionally illiterate as ignorance of reading, writing, and arithmetic". (Danveliuk and Wright, 1981 and Morris and Johnson, 1981).

The importance of using computers in high school science courses cannot be overlooked. Computers are an indispensable tool in the sciences, thus an understanding of any science requires also some knowledge of computer oriented data analysis (Morris and Johnson, 1981). The use of computers for high school science labs broadens the kinds of experiments that can be performed and increases the rate at which data can be gathered and analyzed. More time can be devoted to understanding the scientific phenomena since less time is used for calculation and presentation of

data. Hand calculations are also distracting because they occupy most of the lab time and students tend to focus on them instead of the scientific principles being investigated (Tinker, 1981).

PURPOSE

The purpose of this resource guide is to present a list of the software available for high school physical science/physics for the four most popular microcomputers: Apple II, Pet, TRS-80, and Atari. The resource guide will consist of the following:

1. A list and description of the high school physical science/physics software available for AISD teachers in the various Resource Centers.
2. A list and description of the commercial software for high school physical science/physics.
3. Checklists for evaluating computer instructional programs.
4. An annotated bibliography of microcomputer publications.

RATIONALE

Blauchke (1979), Tinker (1981), and others have pointed out that the major impediment limiting the widespread and effective use of microcomputers in secondary schools is the availability of related, quality software. Furthermore, many teachers are not ware of what software is available and where even though agencies have been established for sharing of efforts (Charp, 1981). These fundamental problems confronting computers in education and the fact that every high school in AISD has computers justify the development of this physical science/physics

software resource guide. Science teachers should have easy access to the software available, avoiding a time-consuming search and thus spending more time assessing the effectiveness of the programs.

CHAPTER II

REVIEW OF THE LITERATURE

Computers have been in use since the 1940's. Between 1948 and 1965 they were used mainly for computing numbers. However, in the late 1950's, the computer industry used computer-based instruction to train their own personnel. Around the same time, educators focused on programmed instruction as a means toward individualized instruction. Computer-assisted instruction was an almost natural combination of emerging computer technology and the programmed instruction movement. The use of computers for instruction expanded during the 1960's and 1970's.

The Coordinated Science Laboratory at the University of Illinois started the PLATO (Programmed Logic for Automatic Teaching Operations) system in 1960. In 1963, the Stanford CAI project was started and in 1967 the Stanford Drill-and-Practice System was designed. In 1967 the Individual Communication System (INDICOM) launched the first public school CAI project in the Midwest. In the late 1960's (1966-68), the Commission on Engineering Education developed the Engineering Concepts Curriculum Project (ECCP). ECCP, a high school course, attempted to provide high school students with an understanding of the impact of technology on the world. Among other activities, ECCP included the use of computer resources (David, 1966). The Massachusetts Institute of Technology developed project TURTLE CAI in the 1970's (Burns and Bozeman, 1981).

In 1957 a computer filled a large room and "the languages were archaic by present standards." The cost for such a computer was

astronomical. By 1978 computers (microcomputers) could be placed on a desk top and were relatively inexpensive (Vannatta, 1981).

Besides the decreasing cost of computers, the main reason for the growing use of computers is that they are incredibly fast and accurate machines which allow people to do things in a manner that was not possible before. Computer programs can be very useful when it comes to providing patient routine drills on basic concepts (Charp, 1981). Few educational media hold the potential for individualizing instruction and for making information easily available as does the computer (Caldwell, 1981).

The following is a list of some of the ways that computers can be used in educational settings:

1. as a means of providing practice and reinforcement of learning
2. as a vehicle to teach computer literacy, a must for all educated citizens of the 80's and beyond
3. to teach programming skills to all who have interest and aptitude
4. as a means of instructing in a tutorial mode especially for both extremes on the learning scale
5. as a remarkably appealing and effective audio-visual device
6. to introduce students to a rapidly expanding career field
7. to simulate problem solving situations and encourage participation in the problem solving process
8. as a tool to test, analyze, and adapt instruction to individual differences
9. as a means of reporting to students and parents
10. as a record keeping device for individual and group progress or

achievement

11. to manage instruction by objectives
12. to keep inventories, attendance, and other records related to instruction
13. to motivate advanced students to surpass the expectations of normal or accelerated classes
14. to serve as a research tool (Vannatta, 1981).

Computer-Based Education (CBE) refers to any use of the computer to support educational activities. Using the computer directly as a teaching machine to present and reinforce instructional content is known as Computer-Assisted Instruction (CAI). It includes drill and practice, tutorial, simulations, testing, and problem solving. Computer Managed Instruction (CMI) uses computers to assist in classroom management (Caldwell, 1981).

CAI is considered to be beneficial because it possesses the potentialities of correcting responses, keeping records, and test averaging, thus relieving the teacher of routine work. Since teachers can save time by using CAI, especially in tasks that are incidentally related to education, CAI can free the teacher for assignments such as inspiring creativity, reinforcing curiosity, and developing interpersonal activities (Hausman, 1967). Computers (CAI) have capabilities for dynamic branching, storing large files of data, score keeping, and dynamic graphic displays (Gage, 1975). Computer lab simulations in place of labs in the long run are cost effective and less dangerous. Computer simulations allow students to make judgments and decisions based on logic,

observations, and their knowledge of the real world, resulting in prepared individuals for the real world. CAI changes passive learning to active experience (Noonam, 1981). A significant factor in the learning process provided by computers is the speed with which they can process a response and provided feedback (Eisele, 1980). With a computer, students can learn and practice problem-solving skills in a number of settings and in nearly all subject areas (Eisele, 1981).

The effectiveness of using computers in education has yield conflicting results. The following describes outcomes of some computer oriented programs and research results on CAI.

As early as 1964, Dececco reported that research in schools and colleges indicated that what was then taught by teachers, textbook, lecture, or film could be taught in half the time with half the effort by a machine. Roe found in his testing of 186 college freshmen taking an elementary probability theory course that results obtained from a standard lecture were slightly inferior to those obtained from the same course using computer programmed instruction (Fry, 1963). Students in a computer-assisted chemistry course at the University of Texas covered more material and obtained higher grades on departmental tests when compared with a control group (Messick, 1978).

When Project Physics using CAI at Marblehead High School was added to the curriculum in 1971-72, enrollment increased rapidly. The instructor stated that the use of computers had saved him 2-3 hours per week. He concluded that a. for those topics in physics where it is valuable to show rapidly the effect of varying parameters, the computer

has great power and is a most effective medium, b. the computer is an extraordinary gameplaying and simulation device, capturing student interest as they do, is an exciting new dimension, and c. the computer is a labor-saving bookkeeper (Harvey, 1978).

Robitaille found results that did not support the trend of increase achievement with CAI. He evaluated two ninth grade algebra classes in each of two schools and collected data concerning student attitude and achievement. The results showed a significant difference in achievement favoring the non-computer group. Lecuyer investigated the effectiveness of using CAI in a math course. At the end of the course he found no significant difference in math achievement between the CAI course and those who learned the conventional way (Overton, 1981).

Burns and Bozeman (1981) paraphrased the results of a review of research literature on CAI effectiveness compiled by Edward et al.:

1. All studies showed that it took less time for students to learn through CAI than through other methods.
2. CAI has been shown to be equally effective related to student achievement when compared with other non-traditional instructional methods.
3. Based on available evidence, it cannot be concluded that any given CAI mode is more effective relative to student achievement than other modes.
4. All studies showed normal instruction supplemented by CAI to be more effective than normal instruction alone.
5. When CAI was substituted, in whole or in part for traditional instruction, 45% of the studies demonstrated greater achievement gains by CAI students, while 40% found little or no difference, 15% showed mixed results.
6. There is

some evidence that learning retention levels of CAI students may not be as high as those of traditionally taught students.

Contradictory to the above, in a review of secondary level CAI, Thomas concluded that achievement gains over more traditional methods are the norm and that retention is equal to that obtained in traditional instruction (Burns and Bozeman, 1981).

Even though some research results on the effectiveness of CAI are inconclusive and conflicting, studies in general conclude that CAI is effective. Furthermore, studies have provided some guidance in identifying the effectiveness of CAI under certain conditions. These conditions are discussed below.

The sciences and foreign languages are areas in which CAI programs have consistently been shown to be effective. CAI drill-and-practice programs have been found to provide a significant advantage over traditional instruction in the sciences and foreign language. A CAI course with branching proved to be more effective than a non-branching version of the same course. Branching allows students to progress at their own rates and permits repeated review until mastery. CAI's usefulness is affected by student familiarity with and attitude toward CAI. Prompt feedback helps students remember more from a lesson (Dence, 1980). A study revealed that students who received feedback with their name and an explanation of the correct answer scored higher on the final exam than those who received feedback with the absence of the student's name (Overton, 1981). CAI has been shown to be especially beneficial for minority and/or economically disadvantaged students. (This is

attributed to immediate feedback and encouragement offered along the way.) (Charp, 1981).

Clement (1980) states that in general students' attitudes toward CBE have been positive at all levels. Some of the reasons for these positive attitudes are: 1. self-pace (students have time to absorb and comprehend the material without inconveniencing another person), 2. lack of embarrassment when mistakes are made, 3. immediate feedback (if the answer is correct or wrong), 4. a general feeling that they learn better through the computer, 5. lack of subjective evaluation (the computer bases its evaluation on students performance not on personal characteristics of a student or his social relationship with the teacher).

The learning theory involved in CAI is: 1. The subject matter is broken up into small units. 2. At least part of the unit requires some type of response from the student. Active participation on the part of the student is required. 3. The student is provided immediate feedback and reinforcement. 4. The units are arranged in careful sequence. 5. The programs are aimed at specific goals. 6. Revisions are based on student responses. 7. The student is usually free to vary his own rate of learning. These principles are associated chiefly with the work of psychologists B. F. Skinner on programmed instruction. Support also comes from Pressey's theory that more efficient learning occurs when the student is actively engaged in the process and Thorndike's theory of repetition for learning (drill and practice) (Fry, 1963, and Dececco, 1964).

In summary CAI is an effective method of instruction with a long list of advantages. The list of the educational uses of computers is also long. Computers can be programmed to perform work needed in many of the processes of instructional management, delivery to a group or individual, design and development, evaluation, and research.

CHAPTER III

RESOURCE GUIDE

Objectives

1. To provide AISD teachers with a list of the software for physical science and physics that are readily available for teachers.
2. To provide teacher awareness of the programs available for high school physical science/physics.
3. To provide teachers with a guide that will help them evaluate computer instructional programs.
4. To provide teachers with a bibliography of educational computer-related publications.

Types of CAI programs

1. Problem-solving programs are used to solve subjected-oriented problems.
2. Drill and practice programs are used for concepts that require practice for mastery. This could be definitions, chemical nomenclature, phyla, etc.
3. Tutorial programs present new material directly from the computer. The computer monitors the student's learning activities which include asking questions and depending on the student's response, branches within the program.
4. Simulations create an artificial system whose behavior is either the same as the one being studied or is related to it in some simple way. Simulation programs simulated anything from chemical, physical or social situations to psychological testings without the constraints

of time, space, or equipment. Simulations allow students to interact with any number of simulated real life events without the attendant dangers of chemical burns, a nuclear meltdown, or crashing a plane.

5. Testing programs asks the test questions, checks the answers, and records the grade (Overton, 1981).

Every science has certain topics and objectives that can be better learned by interaction with an appropriate computer program. Lab simulations allow students to investigate experimental behavior that lies outside the physical constraints of the lab. "You can enter in the gravitational force of planets and then see the planets interact with each other" (Morton, 1980). Test programs can provide immediate feedback at the time the student is taking the test. Tutorial programs allows the student a private tutor. Problem solving programs, for example, can display the laws of physics graphically and allow students to see the results of varying not only the initial conditions but even the laws themselves (Bork, 1981).

HOW TO ASSESS A PROGRAM

Computer instructional programs are written by many individuals, some whose knowledge about the psychology of human learning and individual differences may be limited. Anyone who is a prospective purchaser and user of instructional programs should have some criteria to assess the programs for its effectiveness and validity. Criteria useful for assessing programs should include:

1. Examine the internal characteristics of the program. This refers to features that can be revealed through visual inspection of the program. They contain:
 - a. content - is the subject matter factually correct and current,
 - b. organization of the material, and
 - c. information of length of prompting, frequency of response, and reinforcement.
2. Examine external information about the program. This refers to features that cannot be observed by inspecting the program itself, such as characteristics of its performance as a teaching instrument, qualifications of the author, history of the program's development, tryouts and revision, test data indicating gains in achievement produced by the use of the program. Reviews in journals about the program or the program manual can help reveal this information.
3. Determine if the program fits into the curriculum.
4. Inspect the program carefully for the content area which it is designed to teach and check if the objectives are met.
5. Specify prior knowledge and ability of the learners. This will serve to identify the pre-program base line from which gains may be measured and also indicates what prerequisites are needed in order to

learn effectively from the program. Learner characteristics may be specified as an aspect of the programs' purpose and intended use.

6. Look for the following information that may be in the manual: a. The amount of time learners of different ability spent on various portions of the program and the time lapse between the completion of the program and the criterion test. b. The program effectiveness based on measurement of student performance on pre-and-post-program criterion tests. The average level of performance on the specified pre-and-post-program tests of achievement. c. The kind and amount of student data obtained and the way in which the response data was used in revising the program. and d. The performance characteristics on which the published program was based (Dececco, 1964).

Checklist I is a list for judging programs that evaluates the programs beyond the program's learning characteristics (see Appendix B, page 72).

Checklist II, found on Appendix B, can be used to help identify strength and weakness of a particular learning computer program. This checklist is probably more practical for individual teachers assessing certain programs. Checklist II has three columns: the first is for identifying expectations of the instructional program in question, the second is for marking those expected characteristics which are actually found in the computer program, and the third is for verifying that the other characteristics are accounted for in the rest of the learning environment. It should be kept in mind that CAI programs rarely are intended as complete self-contained units to provide all the factors of

a good learning situation. "Judgement should be made on the basis of what is expected of the program itself relative to the quality of the total learning environment" (Wade, 1980). Checklist II is based on Gagne and Briggs characteristics of instructional programs.

UT Education Resource Center

The University of Texas Education Resource Center Microcomputer Lab has microcomputers and software that teachers can use, however, UT students have priority. The following is a list of the software available for physical science and physics at the high school level.

Chelsa Science Simulations Series for Physics

This includes Interp-Wave Superposition, Scatter (on particle scattering), and Newton Satellite Orbits.

TRS-80, manual.

Mathematics Volume 2, MECC

Includes a tutorial on the conversion of English liquid and length measurements using examples of quarts and gallons, then feet and yards, drill and practice on length, time, and weight measurements. Apple II.

Radio Shack Graphical Analysis of Experimental Data

Math and physics programs that allow students to graphically analyze up to 50 data pairs from an experiment. TRS-80, tape 16K, diskette 32K, 48K.

Science Volume 2, MECC

Science simulations include: Cell Membrane, Collide, Diffusion, Nuclear Simulation, Pest, Radar, and Snell (a simulation on the refraction of light waves. Apple II, Diskette 32K, and manual.

Tribbles

An introduction to scientific method, includes an introductory unit, evaluation, and conclusions. Conduit.

Region XIII Resource Center

The Region XIII Resource Center Microcomputer Lab has microcomputers and software available for AISD teachers. The following is a list of the software available for physical science and physics.

Graphical Analysis of Experimental Data

A physics program that allows secondary students to solve problems by graphically analyzing experimental data. It includes problems on pendulum motion, friction, refraction of light, Boyle's Law, and others. TRS-80, Tape 16K, Diskett 16K, 32K, 48K

Graphing Package

Produces bar graphs, polar graphs, Cartesian coordinate graphs, parametric graphs, linear regression, and parabolic regression graphs. TRS-80 Level II 4K tape

Interpreting Graphs in Physics: Position vs Time, Velocity vs Time

A physics programs that allows secondary students to study rectilinear motion. TRS-80, Tape, or diskette 16K, 32K, 48K.

Mathematics Volume 2, MECC

Includes a tutorial on the conversion of English liquid and length measurements using examples of quarts and gallons, then feet and yards, drill and practice on length, time, and weight measurements. Apple II.

Science Volum 2, MECC

Science simulations include: Cell Membrane, Collide, Diffusion, Nuclear simulation, Pest, Radar, and Snell (a simulation of refraction of light waves). Apple II, diskette 32K, manual

Three Mile Island

Simulation of a pressurized nuclear reactor. Apple II, 48K.

Vector Addition Program

A secondary physics program containing problems for students to solve on vector concepts. Problem topics include velocity and acceleration, force, gravitation, conservation of momentum, and electric forces and fields. TRS-80, diskette 16K, 32K, 48K.

SOFTWARE FOR PHYSICAL SCIENCE/PHYSICS

The following pages list the commercial high school physical science/physics software available for Apple, Atari, Pet, and TRS-80. The list includes the name of the program, a description of the program, the name of the distributor of the program, and memory requirements.

Apple II Software for Physical Science/Physics

Apple Physics

This includes 11 disks, 75 programs for physics. Cross Educational Software, 48K. The programs are listed below.

Vectors and Graphing

This includes Vector Resolution, Vector Addition, Dot Products, Cross Products, Vector products with unit vectors, vector quiz, and data graph.

Statics

This includes statics method, easy beam problems, general beam problems, ladders, and inclined planes.

Motion

This includes projectile, graphing motion, gravity problems, one dimensional kinematics, motion on an inclined plane, and rotational acceleration.

Conservation Laws

This includes, linear momentum, angular momentum, energy of a bouncing ball, conservation of energy, conservative forces, non-conservative forces, one dimensional collisions, and inelastic collisions.

Circular Motion

This includes circular motion at constant speed and during acceleration, simple harmonic motion, the orbit theory, and a round orbit game.

Thermodynamics

This includes calorimetry, ideal gas cycles, heat engines theory and applications, thermodynamic processes and cycles, and molecular motion and gas pressure.

Electricity and Magnetism

This includes Gauss's Law, resistor combinations, RC response,

Lorentz Force, Ampere's Law, capacitor combinations, and RCL circuits.

Optics

This includes mirror ray diagrams, lens ray diagrams, types of images, waves, diffraction, and the laser.

Atomic Physics

This includes radioactive decay, Rutherford Scattering, hydrogen atom, photons and particles, and nuclear reactions.

Solar System Astronomy

This includes inner planets, outer planets, comet structure, life in the solar system, evolution of the sun, paddle graphics drawing utility and comet structure.

Stellar Astronomy

This includes constellation pictures and quiz, Sirius and the White Dwarf, origin of the elements, galaxies, cosmology, the Doppler Effect, types of stars, and death of a star.

Basic Electricity

Introduces the student to the fundamental aspects of electricity such as closed and short circuits. It includes a lesson, puzzle, quiz, and demonstration. Ideatech Co., 48K.

Basic Electricity

3 programs: Series, Parallel, and Network which provide practice in calculating current, voltage, and resistance in D.C. circuits. Programs for Learning, Inc., 48K.

Computers, calculators, and Science

Designed to teach students how to use the Apple as a tool to solve problems in science. Program Effectiveness through Science.

Element

Drill of element symbols based on the periodic chart. Philadelphia School District.

Energy and Environment

Four programs designed to be used with physical science courses. It includes simulation on a dynamic population and programs that calculate

the earth surface temperature for various CO_2 concentrations. COMPRESS, 48K.

Fundamental Skills for General Chemistry

Twelve programs: Baleq

A drill on balancing equations.

Convert

A drill on Metric/English conversions.

Density

Practice on density, mass, and volume problems.

Element

A drill on symbols, atomic number, and electron configuration of the first 20 elements.

EXP

A tutorial exercise explaining exponential notation.

Ions

A drill concerning symbols and charges for common ions.

Metric

A drill on SI units of mass, length, and volume.

MO/WT

Practice in computing formula weights.

NOMEN

A drill on names and formulas for common compounds.

Sighelp

A drill on significant figures.

Symbol

A drill on names and symbols of elements.

Temp

Practice with temperature conversions.

Group Velocity

Students use game paddles to control wave velocity and wavelength to demonstrate a traveling sine wave and two types of wave groups by controlling wave velocity and group velocity. Students select values for frequency, time, and wave number to display velocity, oscillation, cosine wave, moving waves, and group waves. Conduit, 48K.

Introductory Mechanics for the Apple II

Topics: Newton's Second Law, harmonic oscillator, and motion of particles in 2 dimensions. This package epitomizes the simplicity and power of applying the computer to solving problems in physics. It focus on the application of the 2nd. law to the simple harmonic oscillator and to the motion of particles in 2 dimensions under the influence of uniform fields or one or more force centers. Conduit, 48K.

Interp-Wave Superposition

Topics on wave superposition and diffraction patterns. This unit on wave superposition is designed to improve students understanding of the use of models in physics using the wave theory of light. Conduit, 48K.

Isaac Newton

Challenges the players to assemble evidence and discern the underlying "laws of nature" that have produced the evidence. Players intervene actively by proposing experiments to determine if new data conforms to the "laws of nature" in question. Difficulty level is set by the students. Krell Software.

Lab Plot

Helps analyze experimental data from the lab or classwork. It also teaches how to use an empirical method of plotting for straight lines to determine the natural law relating their variables. Educational Courseware, 48K.

Magic Flag

Illustrates concepts of entropy and randomness by showing how patterns destroy themselves when forced to change in accordance with their

environment. The Magic Flag changes its spots, depending on their color or the color of their neighbors. COMPRESS, 48K.

Newton-Satellite Orbits

This unit is designed to help students achieve an appreciation of how the application of Newton's second law and Law of Gravitation lead to the prediction of satellite orbits. Conduit, 48K.

Period

An exercise with the periodic table. Philadelphia School District.

Physics

Displays graphs and experimental set-ups. Allows variables to change questions, experiments, and problems. Stores students names and grades. 8 programs: Circular Motion, Newton's Laws, Acceleration, Uniform Motion, Free Fall, Projectile Problems, Momentum, and Work and Energy. J. & S. Software, 48K.

Physics I

Microphys Programs

Contains the following programs:

Linear Kinematics

Generates 5 questions dealing with linear motion and the analysis of a graph of instantaneous speed versus time.

Projectile Motion

Generates 11 questions dealing with the analysis of a projectile in flight. The basic definitions of kinematics are reviewed.

Momentum and Energy

Generates 11 questions dealing with the concepts of linear momentum, impulse, and kinetic energy.

Energy and the Inclined Plane

Generates 10 questions dealing with the analysis of the motion of a particle on an incline plane. The concepts of work, kinetic energy, and potential energy are reviewed.

Inelastic Collisions

Generates 7 questions dealing with the analysis of an inelastic

collision. The concepts of linear momentum and kinetic energy are reviewed.

Centripetal Force

Generates 6 questions dealing with the analysis of the motion of a particle undergoing uniform circular motion.

Pulley System-Machines

Generates 7 questions dealing with the analysis of a pulley system consisting of single, double, or triple fixed and moveable blocks. The concepts of work and efficiency are reviewed.

Calorimetry

Generates 4 questions dealing with the principle of calorimetry. The definition of specific heat capacity and the conservation of energy principle are reviewed.

Specific Heat Capacity

Generates 4 questions dealing with the definition of specific heat capacity.

Heats of Fusion/Vaporization

Generates 3 questions dealing with the concepts of fusion and vaporization.

Vector Analysis I

Generates problems in which the student is asked to determine the magnitude and direction of the resultant of a concurrent system of 3 to 5 vectors.

Vector Analysis II

A utility program designed to determine the magnitude and direction of a system of concurrent vectors.

Projectile Analysis

A utility program designed to solve the general projectile motion problem. Time of flight, horizontal range, final velocity, and angle of impact are among the values determined.

Calorimetry Analysis

A utility program designed to solve the various time-consuming problems involved in the study of calorimetry. Substances undergoing changes in phase and temperature may be dealt with by this program.

Physics II

Microphys Programs

This package contains the following programs:

Specific Gas Laws

Generates 3 questions dealing with the gases undergoing isothermal, isobaric, and isovolumic processes. Boyles', Charle's, and Gay-Laussac's Laws are reviewed.

General Gas Law

Generates questions dealing with the behavior of a gas undergoing a general process in which all 3 thermodynamic variables may change.

Thermodynamics I

Generates a series of 5 questions dealing with a confined gas which undergoes an isobaric process. The concepts of molar heat capacity, Charle's Law, and the First Law of Thermodynamics are reviewed.

Thermodynamics II

Generates 5 questions dealing with a confined gas which undergoes an isobaric compression during which a quantity of heat is removed.

Transverse Standing Waves

Generates 4 questions dealing with the study of the standing wave pattern established in a wire which is fastened at both ends.

Longitudinal Standing Waves

Generates 4 questions dealing with the longitudinal wave pattern established in open and closed organ pipes.

Mirror and Lenses

Generates 5 questions dealing with the image forming properties

of convex and concave mirrors and lenses.

Refraction of Light

Generates 3 questions dealing with the behavior of light rays striking a planar interface between 2 optical media.

Series Circuit Analysis

Generates 10 questions dealing with the analysis of a series circuit consisting of 3 resistors and a battery. The concepts of resistance, potential difference, and power are reviewed.

Parallel Circuit Analysis I

Generates 10 questions dealing with the analysis of a parallel circuit consisting of 3 resistors and a battery. The concepts of resistance, potential difference, and power are reviewed.

Parallel Circuit Analysis II

Generates 6 questions dealing with the analysis of a parallel circuit consisting of 3 resistors and a battery. The concepts of resistance, potential difference, and Ohm's Law are reviewed.

Series/Parallel Circuit Analysis

Generates 6 questions dealing with the analysis of a circuit in which a single resistor is in series with a parallel combination of 2 resistors.

Electric Field Analysis

Generates 6 questions dealing with the work done in transferring a charged particle between 2 points in a uniform electric field.

Photoelectric Effect

Generates 4 questions dealing with the analysis of photoelectric emission from the surface of various randomly selected metallic cathodes.

Total Internal Reflection

Generates a series of questions dealing with the reflection of light at appropriate interfaces.

Gas Law Analysis

A utility program designed to solve a large variety of problems in which gases undergo isothermal, isobaric, isovolumic, and general processes .

Optics Analysis

Designed to solve a variety of problems involving the image forming properties of thin lenses and convex and concave mirrors.

Physics Compulab

6 computer simulated physics experiments that enable students to experimentally investigate concepts and phenomena that are difficult or impossible to investigate in a conventional lab. Students make measurements of simulated events in the same way they measure real events, so these experiments can be used in conjunction with conventional experiments to enhance the students' overall lab experience. The programs are Parabolic Motion, Nonconstant Acceleration, Planetary Motion, Wave Motion, and Electric Field. EduTech, 48K.

Scatter-Nuclear Scattering

Simulations on nuclear scattering investigations. The programs give students experience in deducing the size, shape, and force law of a single scattering center, and the scattering of alpha particles by a metal foil. Conduit, 48K.

Science Volume I

It includes Atom (a program which calculates the atomic weight when given information on various isotopes of elements), Buffalo, Charge (a simulation of the physics Millikan oil drop experiment), Decay 1 (a game to aid in understanding radioactive decay), Newton 2 (a game which reinforces the concept of vectors), Slits (simulation of Young's double slit physics experiment), Tag, and Whales. Minnesota Educational Computing Consortium (MECC), 32K.

Science Volume 2

This includes Cell Membrane, Collide (a simulation of the collision

of 2 bodies which displays the outcomes in terms of momentum and kinetic energy, Diffusion (a simulation on the relative diffusion rates of gases), ICBM, Nuclear Simulation (a simulation which illustrates the radioactive decay of 9 different isotopes), Pest, Radar, and Snell (a simulation of the refraction of light waves as they pass between 2 mediums). MECC, 32K.

Scientific Measurements

This program is about graduated cylinder, metric rulers, and beam balances. Micro Power & Light Co., 48K.

Scientific Method

Covers observation (use of the senses), generalization (stating a hypothesis), measurement, and verification involving experimentation. Micro Power & Light, 48K.

Scientific Plotter

Produces high-resolution graphs. User controls the scale and endpoints of the graph. Text labels can be place anywhere on the screen. Creative Computing, 48K.

Simple Machines

Describes the 6 simple machines and provides exercises on how each machine can be used. Micro Power and Light, 32K.

Slits

Graphically performs Young's double slit experiment. Philadelphia School District.

Snell

A pictorial representaion of Snell's Law. Philadelphia School District.

Target

Students take turns firing at an enemy, using initial conditions obtained by solving individualized projectile motion problems. Since the enemy is prepared to fire back, the students must be ready with an answer when he gets to the Apple. Depending on their performance

students get promoted, retired, or "killed in action".

Three Mile Island

Simulation of a pressurized nuclear reactor. Four displays monitor the containment building, the turbines, the filters, condensor, reactor core, and pump house. The valves and pumps of the reactors, and the turbines, filters, and control rods can be controlled by the keyboard. Micro Users Software Exchange (MUSE), 48K.

Tribbles

Consists of a tutorial and simulation program. The tutorial presents students with a problem and guides them to its solution. The simulation provides the data for making observations and for forming tentative explanations and testing predictions. Conduit, 48K.

(Hepler, 1982 and Swift, 1982)

Atari Software for Physical Science/Physics

Active Circuit Analysis Program (ACAP)

ACAP is an active and passive circuit analysis program. It can be used to solve for the node voltage of a network. The circuit elements which can be analyzed by ACAP are resistors, capacitors, inductors, voltage sources, current sources, and a voltage-controlled current source. To describe a circuit to ACAP editor, you enter it in a simple algebraic form. Using the ACAP editor, you may easily enter and change the element descriptions. You may also save the circuit description on tape/diskette in order to later recall it. Dynacomp, 48K.

Basic Electricity

This program's topics include circuits, units, and symbols, Ohm's Law, and AC analysis. Atari

Flight Simulator

Learn from this realistic, mathematical simulation which allows you to take-off, fly, navigate, and land an airplane. The program employs kinematics, aerodynamic equations, as well as applies the characteristics of a real airfoil to simulate the response of flying machines ranging from gliders to space shuttles. Flight Simulator realistically portrays the problems associated with stalls, landing with the nose wheel first, cross winds, etc. You can practice touch and go landings, take a cross-country trip, or just practice exercising the flight controls; flaps, trim, elevators, bank, and throttle. Flight Simulator is supplied with a 27 page manual which describes using the program. The manual also contains detailed explanations of many of the technical aspects of the simulation. 16K Level I, Model I or III, Dynacomp.

Graphit

A utility program that can draw graphs and can save old data and compare it to new data. Atari.

Hysis

A game that involves jacking up and changing the tires of racing cars. The concepts of hydraulics and pistons are covered. Atari

Logic Simulator

This program can be used to test a circuit design. The circuit elements which may be treated by Logic Simulator include the following: multiple input AND, NAND, OR, NOR EXOR AND EXNOR Gates, inverters, J-K and D Flip-flops, and one shots. Inputs may be clocked in with varying clock cycle lengths and displacements. Change of state delays may be introduced to test for real life glitches and race conditions. The response of the system is available for display every clock cycle and, at the user's option, a timing diagram for any given set of logic nodes may be simultaneously plotted using HIRES graphics. Logic Simulator is supplied with a 9-page instruction manual and is ideal for use in the classroom where the student may design logic circuits and quickly test them. Dynacomp

Mathematics Volume 2

Includes a tutorial on the conversion of English liquid and length measurements using examples of quarts and gallons, then feet and yards, drill and practice on length, time, and weight measurements. MECC

PHYSICS

Physics course includes the following programs: (Dorsett)

1. Force of Motion - properties of matter, three states of matter, mass, gravity, inertia, energy, force, friction (static, dynamic) displacement, movement, velocity, acceleration, turning force, Newton's Laws, attraction force, spread force, speed.
2. Motion, Gravity & Energy - Issac Newton: gravity & masses, lifting forces, gravitational attraction, measuring gravity, acceleration of gravity, velocity, centrifugal force formula, overcoming gravity, satellites, synchronous satellite, radius of orbits, reduced gravity, energy (kinetic, mechanical, electrical, potential, elastic).
3. Dynamics & Gyroscopes - mechanics, mass, force, motion, dynamics, kinetic energy, gyroscopic forces, gyroscopic inertia, precession, gimbals, gyro reference, operations with kinetic energy, joules, formulas for determining energy potential, tilt, speed, calories.
4. Certain Properties of Matter - elementary particles, molecules, compounds, mixtures, bulk matter, solids, liquids, gases, specific density, specific gravity, elasticity, coefficients of elasticity,

bouyancy, adhesion, capillary action, kinetic theory of gases, absolute pressure, Boyle's Law, Charle's Law, density.

5. Matter and Energy - power, units of energy, joules, measures of energy, multiple forces, specific heat, temperature, pressure, properties of gases, Fahrenheit and Celsius scales, calorie, BTU, energy exchanges, conservation of energy, energy transformation, momentum.
6. Sound - amplifiers, medium, human hearing, transverse waves, compression waves, velocity of sound, amplitude, measure of sound intensity, decibels, pitch, "pure" or "sine" waves, distortion, harmony, frequency ratios, Doppler effect.
7. Light and Optics - wattage, light waves, photons, speed of light, light years, frequency of visible light, refraction, polarized light, indirect use of light, foot-candle, illumination, reflection angle, real image, virtual image, index of refraction, focal length, lens, "thin lens", reciprocal formula, correction lens.
8. Properties of Wave Motion - sound waves, radio waves, motion, propagation of waves, reflection, diffraction, focusing, interference, diffusion, hyperbolas, mixed frequencies, cancelling, reinforcing, Doppler effect lasers, directional phase and color uniformity.
9. Electromagnetic Waves - magnetic fields, electromagnetism, "right hand rule", polarity, "nominal current flow, actual current flow", hertz, electrostatic charge capacitor, sound, radio transmission, photons, electromagnetic radiation, radio waves, light, x-rays, microwaves, infra-red waves.
10. Electrons and Electricity - electrostatic charges, atmospheric electricity, electrostatic "discharge", current, cathode ray tube, ampere, volts, "ground", dimmer, electrical potential, conductors, insulators, resistors, Ohm's Law.
11. Electromagnetism and Alternating Current - magnetic poles, transformers, alternating current, commutators, magnetic fields, sine waves, voltage, direct current, fossil fuels, semiconductors, "pure wave".
12. Solid State Physics and Electronics - magnetism, luminescence, semiconductors, transistors, integrated circuits, iron oxides and

chromium compounds, quantum theory, heat conduction, "superconductivity", semiconductors (N-type, P-type), solar cells, photo cells, microcircuits, transistors, N-P-N transistor.

13. The Elements and their Atoms - atoms, molecules, nucleus, proton, neutron, electron, common elements, compounds, minerals, acid, alkali, atomic weight, electron orbits, ions, alpha particles, atomic mass and charge, atomic number.
14. Atomic Physics and Nuclear Physics - atomic particles (ions, muons, K meson, neutrinos), nuclear particles (xi, sigma, lambda, omega), antimatter, positions, atomic weight, atomic number isotopes, alpha, beta, and gamma rays, half-life, fission.
15. Using Nuclear Physics - polarity of electrons, x-rays, cloud chamber, bubble chamber, photocells, geiger counter, alpha particle, beta particle, neutron, mass of neutrons, beta-decay process, gamma radiation.
16. Theory of Relativity - Einstein (Special theory, General theory), photoelectric effect, Michelson-Morley experiment, Ether Theory, speed of light, energy and mass, mass attraction-gravity, space & time, light rays, perihelion of mercury, quantum theory. Dorsett.

Rendezvous

A space shuttle flight simulation. Extremely realistic. Developed by a NASA senior research scientist. Popular and educational. 48K, Educational Images, Ltd.

Science Volume 1 MECC

It includes Atom (a program which calculates the atomic weight when given information on various isotopes of elements), Buffalo, Charge (a simulation of the physics Millikan oil drop experiment), Decay 1 (a game to aid in understanding radioactive decay), Newton 2 (a game which reinforces the concept of vectors), Slits (simulation of Young's double slits physics experiment), Tag, and Whales. MECC, 32K.

Science Volume 2 MECC

Science simulations include: Cell Membrane, Collide, Diffusion, Nuclear Simulation, Pest, Radar, and Snell (a simulation on the refraction of light waves). MECC

Science Volume 3 MECC

This program covers the topic on heat. MECC.

Scram

Allows students to handle and run a nuclear power plant. Atari.

(Belinky, 1982, Dorsett Educational Systems, Inc. Catalog, 1982, Dynacomp, 1982, and Microphys Programs: Educational Software Catalog, 1982).

Pet Software for Physical Science/Physics

Acceleration due to Gravity

The program shows an animated real-time simulation of a dense object falling from rest. By showing the fall one frame at a time, the student may make measurements of displacement-time data from which he may show that g is constant and calculate its value. Merlan Scientific.

Active Circuit Analysis Program

ACAP is an active and passive circuit analysis program. It can be used to solve for the node voltages of a network. The circuit elements which can be analyzed by ACAP are resistors, capacitors, inductors, voltage sources, current sources, and a voltage-controlled current source. To describe a circuit to ACAP, you enter it in a simple algebraic form. Using the ACAP editor, you may easily enter and change the element descriptions. You may also save the circuit description on tape/diskette in order to later recall it. 48K, Dynacomp.

Average Speed

This program leads the student from a definition of average speed through a series of problems designed to reinforce the concept. Many of the problems are illustrated by animated diagrams. The student is provided with feedback appropriate to his answer. It includes a self test. Merlan Scientific.

Bar Graph

Drill and practice exercise using a bar graph with different pieces of information on it, 10 problems. Micro Ed.

Basic Math Techniques on Significant Figures

This program teaches the student how to judge the number of significant digits in a number. Merlan Scientific, 16K.

Calorimetry

Generates 4 questions dealing with the principle of calorimetry. The definition of specific heat capacity and the conservation of energy principle are reviewed. Merlan Scientific.

Calorimetry Analysis

This utility program is designed to solve the various time-consuming problems involved in the study of calorimetry. Substances undergoing changes in phase and temperature may be dealt with by this program. Microphys.

Centripetal Force

Generates 6 questions dealing with the analysis of the motion of a particle undergoing uniform circular motion. Microphys.

Coordinate

Practice with plotting points on a Cartesian coordinate system. Micro-Ed., 8K.

Electric Field Analysis

Generates 6 questions dealing with the work done in transferring a charged particle between 2 points in a uniform electric field. Microphys.

Energy and The Inclined Plane

Generates a series of 10 questions dealing with the analysis of the motion of a particle on an inclined plane. The concept of work, kinetic energy and potential energy are reviewed. Microphys.

Flight Simulator

Learn from this realistic, mathematical simulation which allows you to take-off, fly, navigate, and land an airplane. The program employs kinematics, aerodynamic equations, as well as applies the characteristics of a real airfoil to simulate the response of flying machines ranging from gliders to space shuttles. Flight Simulator realistically portrays the problems associated with stalls, landing with the nose wheel first, cross winds, etc. You can practice touch and go landings, take a cross-country trip, or just practice exercising the flight controls; flaps, trim, elevators, bank, and throttle. Flight simulator is supplied with a 27 page manual which describes using the program. The manual also contains detailed explanations of many of the technical aspects of the simulation. Dynacomp.

General Gas Law

Generates questions dealing with the behavior of a gas undergoing a general process in which all three thermodynamic variables may change. Microphys.

Heats of Fusion/Vaporization

Generates 3 questions dealing with the concepts of fusion and vaporization. Microphys.

Inelastic Collisions

Generates 7 questions dealing with the analysis of an inelastic collision. The concepts of linear momentum and kinetic energy are reviewed. Microphys.

Interp - Wave Superposition

Topics include wave superposition and diffraction patterns. This unit on wave superposition is designed to 'improve students' understanding of the use of models in physics using the wave theory of light. Conduit, 16K.

Light Bulbs I

The computer shows a configuration of a bulb, battery, and wire in series. The student must decide whether or not the bulb will light, and if not- why not? You determine the number of circuits problems to be tried. Summary of the results are given at the end. Microcomputers in Education, 8K.

Linear Kinematics

Generates 5 questions dealing with linear motion and the analysis of a graph of instantaneous speed versus time. Microphys.

Logic Simulator

This program can be used to test a circuit design. The circuit elements which are treated by Logic Simulator include the following: multiple input AND, NAND, OR NOR EXOR AND EXNOR Gates, inverters, J-K and D Flip-flops, and one shots. Inputs may be clocked in with varying clock cycle lengths and displacements. Change of state delays may be introduced to test for real life glitches and race conditions. The response of the system is available for display every clock cycle. Logic Simulator is

supplied with a 9-page instruction manual and is ideal for use in the classroom where the student may design logic circuits and quickly test them. Dynacomp, 48K.

Longitudinal Standing Waves

Generates 4 questions dealing with the longitudinal wave pattern established in open and closed organ pipes. Microphys.

Longitudinal Wave Demonstrator

Demonstrates both single pulses and periodic longitudinal waves moving along a spring. Allows user to stop and restart the motion and to show it at different speeds. Merlan Scientific, 16K.

Mirrors and Lenses

Generates 5 questions dealing with the image-forming properties of convex and concave mirrors and lenses. Microphys.

Miscellaneous Metric conversions

Program teaches a method of converting numbers expressed with one metric prefix to another. Merlan Scientific, 16K.

Momentum and Energy

Generates a series of 11 questions dealing with the concepts of linear momentum, impulse, and kinetic energy. Microphys.

Newton-Satellite Orbits

Topics include Newton's Laws, gravitation, and velocity. This unit is designed to help students achieve an appreciation of how the application of Newton's Second Law and Law of Gravitation leads to the prediction of satellite orbits. Conduit, 16K.

Optics Analysis

This utility program is designed to solve a variety of problems involving the image forming properties of thin lenses and concave and convex mirrors. Microphys.

Parallel Circuit Analysis I

Generates 10 questions dealing with the analysis of a parallel circuit

consisting of three resistors and a battery. The concepts of resistance, potential difference, and power are reviewed. Microphys.

Parallel Circuit Analysis II

Generates 6 questions dealing with the analysis of a parallel circuit consisting of three resistors and a battery. The concepts of resistance, potential difference, and Ohm's Law are reviewed. Microphys.

Periodic Motion

Five programs teach the concepts of periodic motion, cycle, longitudinal and transverse vibration, amplitude, phase, period and frequency. Merlan Scientific.

Periodic Waves: Basic Concepts

Three programs which concentrate on periodic waves and introduce the ideas of wavelength, amplitude, period, and frequency. The lessons stress transverse waves with a segment at the end demonstrating longitudinal waves and their related vocabulary. Merlan Scientific.

Periodic Waves: Interference and Standing Waves

Two programs analyze the production of standing waves on a stretched spring, by applying the ideas of interference to the case of periodic wave motion. Merlan Scientific.

Photon Interference

This program simulates random behavior of photons passing through a double slit and slowly produces a statistical pattern of bright and dark bars. Merlan Scientific.

Physics I

This includes the following programs: CHARGE simulates Milliken oil drop experiment. SCATRI computes the distribution of scattered alpha particles. SCATR2 graphs simulated alpha scattering (3 models of atom). SCATR3 plots simulated alpha scattering after Rutherford. SLITS simulates Young's double-slit experiment. Project Local, 4K.

Photoelectric Effect

Generates 4 questions dealing with the analysis of photoelectric emission

from the surfaces of various randomly selected metallic cathodes.

POP

Allows students to study the population dynamics of simple organisms.

Specify the parameters and the computer will graph population over time. Four graphs can appear on the screen at once.

32K.

Polut

Allows you to investigate the problems such as how changes in temperature affect the pollution levels of ponds, rivers, etc. Enter the parameters and the computer will graph the level of pollutant as well as the oxygen content of the water. Three graphs can be displayed at one time.

32K.

Projectile Analysis

This utility program is designed to solve the general projectile motion problem. Time of flight, horizontal range, final velocity, and angle of impact are among the values determined. Microphys.

Projectile Motion

Generates 11 questions dealing with the analysis of a projectile in flight. The basic definitions of kinematics are reviewed. Microphys.

Pulley System-Machines

Generates 7 questions dealing with the analysis of a pulley system consisting of single, double, or triple fixed and moveable blocks. The concepts of work and efficiency are reviewed. Microphys.

Refraction of Light

Generates 3 questions dealing with the behavior of light rays striking a planar interface between two optical media. Microphys.

Ruler Objects - Centimeters

Measure the length of certain objects in cm. Program requires the use of standard objects which are listed in the program documentation or additional items can be "programmed in" by the user. Microcomputers in

in Education, 8K.

Scatter-Nuclear Scattering

Simulations of three models of nuclear scattering investigations. The programs give students experience in deducing the size, shape, and force law of a single scattering center and the scattering of alpha particles by a metal foil. Conduit, 16K.

Series Circuit Analysis

Generates 10 questions dealing with the analysis of a series circuit consisting of three resistors and a battery. The concepts of resistance, potential difference, and power are reviewed. Microphys.

Series/Parallel Circuit Analysis

Generates 6 questions dealing with the analysis of a circuit in which a single resistor is in series with a parallel combination of two resistors. Microphys.

Specific Heat Capacity

Generates 4 questions dealing with the definition of specific heat capacity. Microphys.

Total Internal Reflection

Generates a series of questions dealing with the reflection of light at appropriate interfaces. Microphys.

Transverse Standing Waves

Generates 4 questions dealing with the study of the standing wave pattern established in a wire which is fastened at both ends. Microphys.

Vector Analysis I

Generates problems in which the student is asked to determine the magnitude and direction of the resultant of a concurrent system of three to five vectors. Microphys.

Vector Analysis II

This utility program is designed to determine the magnitude and direction of a system of concurrent vectors. Microphys.

(Ah1, 1982, Dynacomp, 1982, Microphys Programs: Educational Software Catalogue, 1982, and Sam, 1981).

TRS-80 Software for Physical Science/Physics

Active Circuit Analysis Program

ACAP is an active and passive circuit analysis program. It can be used to solve for the node voltages of a network. The circuit elements which can be analyzed by ACAP are resistors, capacitors, inductors, voltage sources, current sources, and a voltage-controlled current source. To describe a circuit to ACAP, you enter it in a simple algebraic form. Using the ACAP editor, you may easily enter and change the element descriptions. You may also save the circuit description on tape/diskette in order to later recall it. Dynacomp, 48K.

Automatic Graphing of function

Graph equations in form $Y=F(x)$, $Y=Y+F(x)$. See graphs of formulas on screen display with option to print. X and Y position automatically with high resolution. David Modney, Model I/III-16K-Level II Mod III.

Computer-Based Physics Lab

Ten traditional experiments including Snell's law, Kepler's second law, pendulum, speed and acceleration, energy, focal length, wave lengths, etc. Educational Images Ltd.

Electronics I - Flashcard Drills

Aids to memorizing data or associations. Set includes laws, measurement, semi-conductors, 5 names in electricity, and a general quiz. Educational Media Associates, Model I/III-16K-Level II/Mod III.

Energy Search

Energy search has students name an energy factor and recreate the steps taken in a search of new energy sources. One micro serves a class of 30 students. McGraw-Hill Book Co., Model III-32K-Disk/Mod III.

English-Metric Conversions

This program is designed to help students become proficient with English-Metric conversion problems. Concept Engineering Associates, Model I-III-16K-Level II/Mod III.

Factor - Label 1.1

A step by step introduction into the use of the factor-label (or dimensional analysis) method of problem solving. Three chapters of instruction, problems, and witticisms. M M Computer Club, Model I/III-32K- Level II/Mod III.

Flight Simulator

Learn from this realistic, mathematical simulation which allows you to take-off, fly, navigate, and land an airplane. The program employs kinematics, aerodynamic equations, as well as applies the characteristics of a real airfoil to simulate the response of flying machines ranging from gliders to space shuttles. Flight Simulator realistically portrays the problems associated with stalls, landing with the nose wheel first, cross winds, etc. Flight Simulator is supplied with a 27 page manual which describes using the program. Dynacomp, 16K.

Graph Builder

11 teaching programs and games teach students to read graphs. Covers x and y coordinates, and representation of numerical data on graphs. Starts with simplest concepts and works up to complicated grid game. Program Design, Inc.

Graphic Package

This package provides a variety of interesting and useful graphing routines. Graphing Package combines text and TRS-80 graphics to plot a variety of functions and other graphs. It includes: bar graph, Cartesian Coordinate graphing, polar coordinate graphing, parametric graphing and linear and parabolic regression. Creative Computing; Cassette (16k), Disk (32K).

Graphical Analysis of Experimental Data

Helps students analyze experimental data by providing a graph of data pairs, an equation of the line of best fit using the least squares method, and projection of the dependent variable value based upon student-provided data. Radio Shack, Model I, III-16K-level II/Mod III.

Interp-Wave Superposition

Topics on wave superposition and diffraction patterns. This unit on

wave superposition is designed to improve student's understanding of the use of models in physics using the wave theory of light.

Conduit, Model I/III-32K-Level III.

Interpreting Graphs in Physics

Allows students to solve problems in kinematics using computer-generated graphs of position vs. time and velocity vs. time. Provides a variety of questions on such concepts as position, speed, velocity, displacement, and acceleration. Radio Shack, Model III-16K.

Introductory Physics Series

Over 35 programs are available which include concepts such as Kinematics, momentum, energy, gas law, optics, circuits, and waves. Each program has a CAI and individualized instruction aspect. Microphys, Model I/III-16K-Level II/Mod III. See Appendix C for detailed descriptions of the programs.

Its About Time

Teaches concepts of time and accommodates one or two at the keyboard. Students may review before graded quiz. Carl A. Goldner.

I.R. Tutor

Introduces students to chain and functional group identification. Animation and graphics are used to demonstrate infrared spectroscopy. Educational Software and Design, Model I/III-16K-Level II/Mod III.

Kinematics

It gives students an unlimited practice in the solving of kinematic problems. Concept Engineering Associates, Model I/III-16K-Level II/Mod III.

Logic Simulator

This program can be used to test a circuit design. The circuit elements which may be treated by Logic Simulator include the following: multiple input AND, NAND, OR NOR, EXOR, AND, EXNOR Gates, inverters, J-K and D Flip-flops, and one shots. Inputs may be clocked in with varying clock cycle lengths and displacements. Change of state delays may be introduced to test for real life glitches and race conditions. Logic Simulator is supplied with a 9-page instruction manual and is ideal for use in the classroom where the student may design logic circuits and quickly

test them. Dynacomp, 48K.

Newton-Satellite Orbits

This unit is designed to help students achieve an appreciation of how the application of Newton's Second Law and Law of Gravitation leads to the prediction of satellite orbits. Conduit, Model I/III-32K-Level III.

Physics Tutorials and Lab Simulations

Programs are interactive with graphics. Custom Comp, Model I-16K-Level II.

Physics Tutorial - Dynamics - Newton's Laws

A tutor program on Newton's laws of motion which provides problems, checks answers, and gives solutions. The Teaching Assistant, Model I/III-16K-Level II/Mod III.

Physics Tutorial - Heat and Temperature - PT. A

An introduction to thermodynamics, practice with conversions of temperature scales, and determination of heat content. The Teaching Assistant, Model I/III-16K-Level II/Mod III.

Physics Tutorial - Heat and Temperature PT. B

A tutor program that covers heat of fusion, heat of vaporization, and method of mixture with subject synopsis. The Teaching Assistant, Model I/III-16K-Level II/Mod III.

Physics Tutorial - Momentum

Includes concepts necessary for an understanding of momentum, impulse, and conservation of momentum are developed and applied with problems, subject synopsis, and solutions. The Teaching Assistant, Model I/III-16K-Level II/Mod III.

Physics With The Computer

Covers mechanics, electricity, magnetism, heat, waves, light, relativity and modern physics. Thirty programs. Educational Images ltd.

Scatter-Nuclear Scattering

Simulations on nuclear scattering investigations. The programs give

students experience in deducing the size, shape, and force law of a single scattering center, and the scattering of alpha particles by a metal foil. Conduit, Model I/III-32K-Level III.

Science Package I

Four programs are included in this package: Electronics (Ohm's Law and practice with graphics), Metric Quiz, Lost on the Moon, and Cup the Ball (a physics lab on the trajectory of a ball rolling off the table-graphics). Micro Learning Ware, Model I/III-16K-Level II/Mod III.

Science Package III

Five programs providing drill and practice with various formulas dealing with the physics of motion. Student is taken through step by step solution if an incorrect response is given. Micro Learning Ware. Model I/III-16K-Level II/Mod III.

Solar Energy Analysis

Allows students to determine the effects of changing variables of air, liquid, or hot water in any climate, simulating energy demands throughout the year. Creative Computing Software, Model I/III-48K-2 disks Level II/Mod III.

Sunheat - Evaluates Solar DHW Systems

User configures and evaluates solar hot water heating systems. Program calculates monthly solar energy used and percent of total load supplied by solar. Solar Trek, Model I/III-16K-Level II/Mod III.

Sunmax Solar Energy Game

Players (1-9) try to guess correct tilt for solar collector to maximize solar energy available for home heating, hot water heating, or home air conditioning at a city selected at random from 200⁺ worldwide cities. Solar Tek, Model I/III-16K-Level II/Mod II.

Sunsim-4

Calculates hourly solar energy and demonstrates use for domestic space heating, cooling and hot water heating using thermal storage, heat exchanger, and chiller. Input includes size of home, storage, and collector. Solar Tek, Model I/III-16K-Level II/Mod III.

The Gas Laws

This program will enable a student to solve a large number of unique problems on gas laws. Concept Engineering Association, Model I/III-16K-Level II/Mod III.

(Ahl, 1982, Belinky, 1982, Dynacomp, 1982, Gattis, 1982, Hepler, 1982, Microphy Programs: Educational Software Catalogue, 1982, and Victor, 1982).

ANNOTATED BIBLIOGRAPHY OF MICROCOMPUTER PUBLICATIONS

The periodicals listed in the following pages were selected from George Culp's Annotated Bibliography of Microcomputer Publications (this was derived from a more complete bibliography developed by Ron Adams) and from Computer-related Journals for Educators developed by the State Department of Public Instruction.

APPLE EDUCATION NEWS

FREE

Box 20485

San Jose, CA

U.S.A. 95160

This newsletter, published occasionally by the Apple Corporation, is a useful source of information on the burgeoning Apple-based CAI programs being developed in American universities, colleges, and schools. It also contains the inevitable glowing performance accounts of the company's educational software, as well as of the software being developed for the Apple by other companies. The newsletter is evidently intended for distribution in computer stores because there is no subscription information in it.

APPLE EDUCATORS¹ NEWSLETTER

U.S.A. \$15

CANADA \$25

9525 Lucerne Street

Ventura, CA

U.S.A. 93004

The newsletter, published every two months, of the Apple for the Teacher group, a California-based organization of elementary and high school teachers dedicated to sharing and developing educational software reviews and information on CAI projects that don't get coverage in the glossy magazines. Recommended.

CALL-A.P.P.L.E.

U.S.A. \$40 membership

304 Main Avenue South

CANADA \$40 membership

Suit 300

Subsequent years \$15

Renton, WA

U.S.A. 98055

Published nine times a year, CALL-A.P.P.L.E., is the magazine of the oldest and most sophisticated of the Apple-user groups--the Apple Puget Sound Program Library Exchange. It is an excellent source of programming tips, utility program listing, software reviews, and product reports. Although it is geared to experienced users, beginners and experts alike may call a "hot line" for advice from 9 a.m. to 3 p.m. and 6 p.m. to 10 p.m. seven days a week. The hot line may save many hours of frustration. I strongly recommend membership in Call-A.P.P.L.E. for serious Apple users.

CLASSROOM COMPUTER NEWS

U.S.A. \$16

Box 266

Cambridge, MA

U.S.A. 02139

A complimentary issue contained the following articles: "Computer Literacy--What Should Schools Be Doing About It?" and "Special Tools for Special Needs". It features articles, editorials, reviews for teachers, school administrators; reviews of software, hardware and books include positive and negative comments, as well as publishers responses; commercial write-ups often indistinguishable in appearance from evaluative reviews; topical news items, calendar of forthcoming meetings, new products listed. 5 issues per year.

COMPUTER AGE

Britain \$67.20

4 Valentine Place

London, Se 1

GREAT BRITAIN

This British monthly is the leading microcomputer journal in the English language. It is comprehensive, well laid out, and written in brisk, erudite, jargon-free style that ordinary mortals can understand. Topics in recent issues included the office of the future, computer literacy, computer-assisted instruction, ergonomics, voice synthesis, the use of micorcomputers in medicine and special education, bubble memory, and artificial intelligence. The magazine has also been featuring excellent tutorials in programming language like PILOT, FORTH, and APL. There's only one problem: The subscription price is seven pounds twenty (\$20) and very reasonable, but the British post office charges a king's ransom to airmail it to Canada and the U.S.--27 pounds--which brings the cost to nearly \$100 a year!

COURSEWARE MAGAZINE

4919 North Millbrook 222

Fresno, CA

U.S.A. 93726

U.S.A. \$50

CANADA \$58

This magazine, edited by educator Dan Isaacson, appears five times during the school year. Advertisements state that it contains "documented educational programs for K-12 students designed to meet teachers' needs." Each issue contains a cassette tape with at least two CAI programs as well as a teacher's guide, a student's guide, and a worksheet. The programs in the first five issues include a spelling drill, a vocabulary drill, an introductory statistics program, two arithmetic tutorials, a measurement-guessing program, and a game to teach alphabetical order. Infoworld reviewer Ramon Zamora said that the first issue of this magazine was a mixture of good intentions, average software, and flawed documentation, but it had considerable potential. (Infoworld, August 31, 1981 pp. 30-31).

CREATIVE COMPUTING

Box 789-M

Morristown, NJ

U.S.A. 07960

U.S.A. \$20

CANADA \$29

Directed toward all personal computer users with special emphasis on use in education; includes hardware and software reviews by staff members and other contributors; numerous general interest articles cover broad spectrum, e.g., product and system descriptions, partial program listings, classroom activities; regular features include book reviews, a legal column, puzzles and several cartoons; offers users of LOGO and of microcomputers from Apple, Atari, IBM, and TRS-80 ideas devoted to their unique concerns; 200+ pages supported by heavy advertising. 9 issues per year.

CUE NEWSLETTER

Independence High School

1776 Educational Park Drive

San Jose, CA

U.S.A. 95133

U.S.A. \$6

CANADA \$8

Published every two months, this is the newsletter of California's computer-using educators, an enthusiastic group of several hundred elementary and

high school teachers who have just started an educational software exchange. Members can buy several diskettes of modest educational programs for the Apple, PET, and TRS-80 for \$10 a diskette. The newsletter outlines CUE's many activities, and prints short but revealing software reviews from a teacher's viewpoint.

EDUCATIONAL COMPUTER MAGAZINE U.S.A. \$12

Box 535 CANADA \$20

Cupertino, CA

U.S.A. 95015

Bimonthly journal contains feature articles about use of computers in education, focusing on very practical applications and topics; contributing authors are educators; also includes editorials, letters from readers, news updates, and new product information; schools may copy articles free of charge; there are no software, but brief commercial descriptions and ads are included.

ELECTRONIC EDUCATION U.S.A. \$10

1311 Executive Center, Suite 220

Tallahassee, Florida

U.S.A. 32301

Focuses on educational applications of microcomputers in the southeastern states; major articles describing activities and concerns throughout the field will appeal to any teacher or administrator; other reports will highlight exemplary microcomputer programs in the Sunbelt; regular columns review new products, cite sources of funds available for projects using computers or other technology. 10 issues per year.

ELECTRONIC LEARNING U.S.A. \$19

902 Sylvan Ave.

Englewood Cliffs, NJ

U.S.A. 07632

Excellent resource for any educator who uses, or is planning to use microcomputers; each issue is filled with easily read, highly relevant articles; regular features include interviews with people working with microcomputers, well-structured reviews of courseware by teachers and other knowledgeable experts, an activity to be performed by students--some requiring a

microcomputer and others directed toward developing computer literacy;
top priority choice. 8 issues per year.

JOURNAL OF COMPUTERS IN SCIENCE TEACHING U.S.A. \$7

Box 4825

Austin, TX

U.S.A. 78765

Published quarterly by the Association for Computers in Science Teaching,
this journal features research reports, tutorials, and software reviews
pertinent to elementary and high school science teaching.

JOURNAL OF COURSEWARE REVIEW U.S.A. \$6.95

Box 28426

San Jose, CA

U.S.A. 95159

A collection of professional reviews of educational software for the Apple.
It is published by the Foundation for the Advancement of Computer-aided
Instruction (formerly the Apple Education Foundation), a non-profit
organization that furnishes hundreds of thousands of dollars worth of
microcomputer equipment each year to people who propose innovative CAI
projects. The first issue is \$6.95.

MICROCOMPUTING U.S.A. \$25

Box 997

CANADA \$27

Farmingdale, NY

U.S.A. 11737

A comprehensive, carefully edited monthly magazine noted for excellent
articles on technical topics and for regular features on the microcomputer
industry, education, business, new products, and book reviews. Serious
microcomputer users may prefer it to Creative Computing. Editor Wayne
Green's perceptive monthly analysis of the industry is indeed worth the
price of Microcomputing. Highly recommended.

NIBBLE U.S.A. \$17.50

Box 325

CANADA \$18.00

Lincoln, MA

U.S.A. 01773

A magazine for advanced Apple users. Each of the eight yearly issues

features at least two major program listings for home, small business, or entertainment use that can be typed into the Apple. It also contains a selection of program tips, hardware construction projects, and product reviews. The major listings may also be obtained on diskettes for \$15 or less. Highly recommended.

PEELINGS II U.S.A. \$21.00

2260 Oleander Street CANADA \$28.50

Las Cruces, NM

U.S.A. 88004

Specifically directed toward Apple users, 50+ page magazine consists primarily of 15 to 20 informative and concise reviews of courseware, games, utility programs, data bases, and hardware for the Apple; editors maintain strict control over advertisements and try to accept only those for worthwhile items; good choice where there is likely to be extensive purchasing of Apple materials. 9 issues per year.

PIPELINE U.S.A. \$25 membership

Conduit

Box 388

Iowa City, IA U.S.A. 52244

A semiannual report of the University of Iowa's CONDUIT organization, a U.S.A. government-supported project designed to develop, evaluate, and market computer-assisted instructional materials for higher education. Members of CONDUIT receive Pipeline, a CAI authoring guide, and brochures on new post-secondary CAI materials, some of which are available for the Apple, PET, and TRS-80. Pipeline contains several short articles on CAI research, as well as a catalogue of \$50 disk-based programs in biology, chemistry, economics, education, geography, psychology, sociology, humanities, management, mathematics, physics, political science, and statistics.

PURSER's MAGAZINE U.S.A. \$5 each issue

P.O. Box 188

Las Cruces, NM

U.S.A. 88004-0188

Guide to computer programs concentrates primarily on Apple and TRS-80 microcomputers; journal consists mainly of reviews of games, but does

include some educational and utility programs; fairly complete evaluations written by editor and staff whose backgrounds are not defined; several short interviews and informative articles are directed toward specific readers, e.g., potential authors; 90+ pages printed on a Radio Shack printer.

SCHOOL MICROWARE REVIEWS: EVALUATION OF EDUCATIONAL SOFTWARE FOR APPLE, PET, TRS-80.

Dresden Associates, P.O. Box 246 U.S.A. \$20
Dresden, Maine
U.S.A. 04342

Aimed toward educators interested in evaluations of programs for the TRS-80, PET, and Apple microcomputers; main section of journal consists of approximately 50 reviews of software from a variety of suppliers; identified educators and magazine staff include positive and negative comments in detailed evaluations; reviews are shared with producers who may add their own comments; also includes comprehensive index of courseware reviewed in other publications; especially useful source will help teachers select quality courseware. Two issues per year.

SCHOOL MICROWARE DIRECTORY U.S.A. \$20
Dresden Associates, P.O. Box 246 CANADA \$20
Dresden, MA
U.S.A. 04342

A typewritten quarterly catalogue of educational software available for the major microcomputers. Entries are listed by subject and grade level ranging from Kindergarten to Grade 12. Unfortunately, the programs are not reviewed.

THE COMPUTING TEACHER U.S.A. \$14.50
Computing Centre, Eastern Oregon State College CANADA \$20
La Grande, OR
U.S.A. 97850

Edited by David Moursund, a leading CAI educator, this journal focuses on teacher education, computer-assisted instruction, and the impact of computers on curriculums. Apart from the usual articles and software

reviews, The Computing Teacher features reports on CAI projects, articles on instructional design, and an assortment of calculator and microcomputer programming assignments that can be adapted to classroom use. 9 issues per year.

(Adams, 1982 and Bland, 1982).

CHAPTER IV

SUMMARY

The low cost of microcomputers have led to an expansion of microcomputers in education. AISD has been affected by this expansion of computers in education and plans to install more microcomputers in the schools in the future. Regardless of the boom of microcomputers in education, there are several factors that have limited the widespread and effective use of microcomputers in secondary schools. Two of these factors include the availability of related, quality software and teacher awareness of what software is available (Blauchke, 1979 and Charp, 1981).

This resource guide provided a list of the physical science/physics software available to AISD teachers in the local resource centers. It also provided a list of the commercial physical science/physics software available for the Apple II, Atari, Pet, and TRS-80 and a bibliography of educational computer-related journals. These lists have been compiled as carefully as possible but they are not guaranteed to be complete lists of all the physical science/physics software available for the mentioned microcomputers.

There are many utility programs available that can be also be used by physical science or physics teachers to take over routine chores such as averaging grades or to help generate puzzles or teacher questions. For example, Teacher Utilities Volume 2,3,4 (MECC) allow the teacher to enter question and answer lessons on the Apple. These types of programs are not included in the resource guide.

APPENDIX A

TABLE 1

ATSD COMPUTER HARDWARE

SCHOOL	BRAND NAME AND MODEL NUMBER	QUANTITY OF LIKE COMPUTERS	AMOUNT OF INTERNAL MEMORY	TYPE OF AUXILIARY STORAGE	TV/CRT	PRINTER	INTERFACE EQUIPMENT
Anderson	TRS 80 Model II	2	16K	Cassette	Yes	Yes	Yes
	Apple II Plus	1	48K	Disk	Yes	No	No
	Apple II Plus	1	48K	Disk	Yes	No	Yes
	TRS 80 Model III	1	32K	Disk	Yes	No	No
	TRS 80 Model III	1	48K	Disk	Yes	Yes	No
Austin	Apple II	4	48K	Disk	Yes	Yes	No
	TI 800	1				Yes	Yes
	TTY 43	2				Yes	Yes
Crockett	Apple II Plus	2	48K	Disk	Yes	No	No
LBJ	Apple II Plus	2	64K, 48K	Disk	Yes	Yes	Yes
	TRS 80	1	16K	Cassette	Yes	Yes	Yes
	Apple II	1	64K	Disk	Yes	No	Yes
	TRS 80	1	16K	Cassette	Yes	Yes	Yes
Johnston	Apple II Plus	10	48K	Disk	Yes	No	Yes
	TTY 43	1			No	Yes	
	TI OMNI 800	1			No	Yes	
	IBM 029	11			No	No	No
	IBM 129	2			No	No	No
	IBM 3742	1			No	No	No
	Honeywell Key-tape	3			No	Yes	No
McCallum	Apple II Plus	1	16K	Disk	Yes	No	No
	Teletype Model 43	2	(terminal uses UT Dec 10, Dec 20, Taurus)				
	TI OMNI 800	1	(terminal uses UT Dec 10, Dec 20, taurus)				
	TRS 80 Model III	1	14K	Cassette	Yes	Yes	No

(COMPUTER HARDWARE)

<u>SCHOOL</u>	<u>BRAND NAME AND MODEL NUMBER</u>	<u>QUANTITY OF LIKE COMPUTERS</u>	<u>AMOUNT OF INTERNAL MEMORY</u>	<u>TYPE OF AUXILIARY STORAGE</u>	<u>TV/CRT</u>	<u>PRINTER</u>	<u>INTERFACE EQUIPMENT</u>
Reagan	Apple II TRS 80	1	48K	Disk	Yes	No	Yes
		1		Cassette	Yes	Yes	Yes
Lanier	32762 25382	1	64K		Yes	No	Yes
	3278-2 7U392	1			Yes	No	No
	TI OMNI 800	1					
	Apple II Plus	1			Yes	No	No
Travis	TRS 80	1	64K	Cassette	Yes	Yes	Yes
	Apple II Plus	1		Disk	Yes	No	No

(Bishop, 1982)

AISD COMPUTER SOFTWARE

<u>SCHOOL</u>	<u>NAME OF SOFTWARE</u>	<u>SUPPLIER AND/OR BRAND NAME</u>	<u>COMMERCIALY OR LOCALLY DEVELOPED</u>	<u>MODE OF INSTRUCTION</u>	<u>SUGGESTED GRADE LEVEL(S)</u>	<u>SUBJECT</u>	<u>COMPUTER BRAND AND MODEL</u>
Anderson	Level 1 Post 2	Radio Shack	Commercially	Drill & Practice Tutorial Simulation	11-12	VOE	TRS 80
	Payroll File	Radio Shack	Commercially	Problem Solving Drill & Practice	10-12	Bus. Ed.	TRS 80
	Bus. Math	Radio Shack	Commercially Locally	Drill & Practice Problem solving	10-12 10-12	Bus. Ed. Bus. Ed.	TRS 80 TRS 80
Austin	Milllican's Oil Drop Young's Interference	MEC	Commercially	Simulation	11-12	Physics	Apple II
	MULT DIV	MEC	Commercially	Simulation	11-12	Physics Math	Apple II
	GRAPH Sine-Wave Addition	Austin High Austin High Austin High Austin High	Locally Locally Locally Locally	Drill & Practice Drill & Practice Simulation Tutorial Simulation	9 9 10-12 11-12	FOM FOM Algebra Physics Trig.	Apple II Apple II Apple II Apple II
Crockett	SEMCALC	Cognitive Research Group	Commercially	Problem Solving	10-12	Math	Apple II
LBJ	SIMCALC	MIT	Locally	Simulation Problem Solving	9	Algebra	Apple II+
	SCRIPSIT	Radio Shack	Commercially	Simulation Problem Solving		VOE	TRS 80
	RAMEX	OMEGA	Commercially	Simulation Problem Solving	11-12	Voc.	Apple II
	SCRIPSIT	Radio Shack	Commercially	Simulation Problem Solving	9-12	Drafting Typing Bus. Math	TRS 80-M

(COMPUTER SOFTWARE-CONTINUE)

<u>SCHOOL</u>	<u>NAME OF SOFTWARE</u>	<u>SUPPLIER AND/OR BRAND NAME</u>	<u>COMMERCIALLY OR LOCALLY DEVELOPED</u>	<u>MODE OF INSTRUCTION</u>	<u>SUGGESTED GRADE LEVEL(S)</u>	<u>SUBJECT</u>	<u>COMPUTER BRAND AND MODEL</u>
Johnston	-----	E. Schilhab	Com. & Loc.	Drill & Practice Tutorial	3-9	Math	Apple II+
Lanier	Apple Corp.	Apple	Commercially	Miscellaneous		Computer	Apple II+
	System Masters						
	Alpha Plot	Beagle Bros.	Commercially	Problem Solving		Computer	Apple II+
	Dos Boss						
	Utility City						
McCallum	SCRIPSIT	Radio Shack	Commercially	Word Processing	11-12	VOE	TRS 80
Reagan	SCRIPSIT	Radio Shack	Commercially	Tutorial	10-12		
Travis	-----	-----	-----	NONE	---	---	----

(Bishop, 1982)

APPENDIX B

CHECKLIST I - FOR JUDGING PROGRAMS

SUBJECT MATTER

- _____ Covers subject (meets desired objectives)
- _____ Faculty opinion
- _____ Authors's reputation
- _____ Publisher's reputation
- _____ Readability level

PROGRAMMING TECHNIQUE

- _____ Logical progression
- _____ Your own students' opinions
- _____ Your own students' error rate
- _____ Your own students' skill level
- _____ Evidence of tryout and revision
- _____ Meaningfulness of responses
- _____ Lesson size
- _____ Branching
- _____ Writer's style
- _____ Pleasing, convenient format
- _____ Response mode
- _____ Prompting

RESULTS

- _____ Evidence of your own students' learning
- _____ Evidence of field trials
- _____ Type of students used in field trials
- _____ How learning measured
- _____ Reputation of psychologist conducting field trials
- _____ Acceptance by faculty and students

EFFICIENCY

- _____ Cost, initial
- _____ Cost, long-term
- _____ Training time required
- _____ Quality of students required (IQ, previous training)
- _____ Quality of instructor required
- _____ Logistics (space, machine need)

CHECKLIST FOR IDENTIFYING LEARNING PROGRAM CHARACTERISTICS

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Program being evaluated _____	Expectation	Present in Program	Provided Outside
The learning must be right			
In harmony with philosophy and goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accurate and up-to-date	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sufficiently complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The learner must be ready			
Intellectual (skills and strategies)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Emotional (curiosity/anxiety, self-worth, reinforcement)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physical (alert, calm, strong)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Learning needs to be managed or facilitated			
Attention gained	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Learner informed of the objective	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recall of prerequisite learnings stimulated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stimulus material presented	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Learning guidance provided	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Performance elicited	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feedback about performance correctness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Performance assessed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Retention and transfer enhanced	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Assimilation must be practicable			
The information must be available	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The information present in logical order	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Repetition used effectively	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Control mechanisms for short-term memory	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provision for coding to and from long-term memory	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Short-term memory not overloaded	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Learning must be efficient			
Characteristics of individual learners considered	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial cost reasonable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Student time used conservatively	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Facilitator/teacher time and energy used efficiently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Totals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(Wade, 1980)

APPENDIX C

INTRODUCTORY PHYSICS SERIES

The following is a description of the Introductory Physics Series programs compiled by Microphys. Each program has a CAI and individualized instruction aspect. The programs can be used for the TRS-80 Model I/III-16K-Level II/Mod III.

Calorimetry

Generates 4 questions dealing with the principle of calorimetry. The definition of specific heat capacity and the conservation energy principle are reviewed.

Calorimetry Analysis

This utility program is designed to solve the various time-consuming problems involved in the study of calorimetry. Substances undergoing changes in phase, as well as changes in temperature, may be dealt with by this problem.

Centripetal Force

Generates a series of 6 questions dealing with the analysis of the motion of a particle undergoing uniform circular motion.

Electric Field Analysis

Generates a series of 6 questions dealing with the work done in transferring a charged particle between two points in a uniform electric field.

Energy and The Inclined Plane

Generates 10 questions dealing with the analysis of the motion of a particle on an inclined plane. The concepts of work, kinetic energy and potential energy are reviewed.

Heats of Fusion/Vaporization

Generates 3 questions dealing with the concepts of fusion and vaporization.

Inelastic Collisions

Generates 7 questions dealing with the analysis of an inelastic collision.

Linear Kinematics

Generates 5 questions dealing with linear motion and the analysis of a graph of instantaneous speed versus time.

Longitudinal Standing Waves

Generates 4 questions dealing with the longitudinal wave pattern established in open and closed organ pipes.

Mirrors and Lenses

Generates 5 questions dealing with the image-forming properties of convex and concave mirrors and lenses.

Momentum and Energy

Generates 11 questions dealing with the concepts of linear momentum, impulse, and kinetic energy.

Optics Analysis

This utility program is designed to solve a variety of problems involving the image forming properties of thin lenses and convex and concave mirrors.

Parallel Circuit Analysis I

Generates 10 questions dealing with the analysis of a parallel circuit consisting of three resistors and a battery. The concepts of resistance, potential difference, and power are thus reviewed.

Parallel Circuit Analysis II

Generates 6 questions dealing with the analysis of a parallel circuit consisting of three resistors and a battery. The concepts of resistance, potential difference, and Ohm's Law are reviewed.

Photoelectric Effect

Generates 4 questions dealing with the analysis of photoelectric emission from the surfaces of various randomly selected metallic cathodes.

Projectile Analysis

This utility program is designed to solve the general projectile motion problem. Time of flight, horizontal range, final velocity, and the angle of impact are among the values determined.

Projectile Motion

Generates 11 questions dealing with the analysis of a projectile in flight. The basic definitions of kinematics are reviewed.

Pulley System-Machines

Generates 7 questions dealing with the analysis of a pulley system consisting of single, double, or triple fixed and moveable blocks. The concepts of work and efficiency are thus reviewed.

Refraction of Light

Generates 3 questions dealing with the behavior of light rays striking a planar interface between two optical media.

Series Circuit Analysis

Generates 10 questions dealing with the analysis of a series circuit consisting of three resistors and a battery. The concepts of resistance, potential difference, and power are reviewed.

Series/Parallel Circuit Analysis

Generates 6 questions dealing with the analysis of a circuit in which a single resistor is in series with a parallel combination of two resistors.

Specific Heat Capacity

Generates 4 questions dealing with the definition of specific heat capacity.

Thermodynamics I

Generates 5 questions dealing with a confined gas which undergoes an isobaric process. The concepts of molar heat capacity, Charles' Law, and the first law of thermodynamics are thus reviewed.

Thermodynamics II

Generates 5 questions dealing with a confined gas which undergoes an isobaric compression during which a quantity of heat is removed.

Total Internal Reflection

Generates a series of questions dealing with the reflection of light at appropriate interfaces.

Transverse Standing Waves

Generates 4 questions dealing with the study of the standing wave pattern

established in a wire which is fastened at both ends.

Vector Analysis I

Generates problems in which the student is asked to determine the magnitude and direction of the resultant of a concurrent system of three to five vectors.

Vector Analysis II

This utility program is designed to determine the magnitude and direction of a system of concurrent vectors.

(Microphys Programs: Educational Software Catalogue, 1982)

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